AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

a1

1. (original): A method for indexing feature vector data space comprising the step of:

(a) adaptively approximating feature vectors on the basis of statistical distribution of feature vector data in the feature vector data space.

2. (original): The method of claim 1, wherein the step (a) further comprises the steps of:

(a-1) measuring the statistical distribution of the feature vector data in the feature vector data space;

(a-2) estimating marginal distribution of the feature vector data using the statistical distribution;

(a-3) dividing the estimated marginal distribution into a plurality of grids in which a probability of disposing the feature vector data in each grid is uniform; and

(a-4) indexing the feature vector data space using the divided grids.

3. (original): The method of claim 2, further comprising prior to step (a-4), the step of updating the grids on the basis of a previous probability distribution function and an updated probability distribution function, when new data is received.

4. (original): The method of claim 2, wherein step (a-4) further comprises indexing using vector approximation (VA) files.

5. (original): The method of claim 2, wherein a number of the plurality of grids is determined by a number of bits assigned to the dimension.

6. (original): The method of claim 2, wherein step (a-2) further comprises the steps of:

a1 Cont'd.

(a-2-1) defining a probability distribution function using a weighted sum of a predetermined distribution function; and

(a-2-2) obtaining an estimated probability distribution function by estimating predetermined parameters using the probability distribution function defined in the step (a-2-1).

7. (original): The method of claim 6, wherein step (a-2-2) further comprises obtaining the estimated probability distribution function by estimating the predetermined parameters using all N predetermined data in each estimation, wherein N is a positive integer, on the basis of an expectation-maximization algorithm using the probability distribution function defined in the step (a-2-1).

8. (original): The method of claim 6, wherein the predetermined distribution function is the Gaussian function.

9. (original): The method of claim 6, wherein the probability distribution function of step (a-2-1) is a one-dimensional signal, p(x), wherein $p(x)=\sum_{j=1}^{N} p(x|j)P(j)$, and wherein $p(x|j)$ is defined as

$$p(x|\mathrm{j})=\frac{1}{\sqrt{2\pi\sigma^2}}\exp\left\{-\frac{(x-\mu_j)^2}{2\sigma_j^2}\right\},$$

wherein coefficient P(j) is a mixing parameter that satisfies the following criterion

$0 \le P(j) \le 1$ and $\sum_{j=1}^{M} P(j) = 1$.

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Cont'd

10. (original): The method of claim 6, wherein the estimated probability distribution function of step (a-2-2) is obtained by finding Φj, j=1, . . . , M, which maximizes

$\Phi(\Phi_1,\ldots,\Phi_M) = \prod_{l=0}^{N} P(v[l] | (\Phi_1,\ldots,\Phi_M)$, where parameters v[$l$], l=1, . . . , N, is a given data set.

11. (original): The method of claim 10, wherein the estimated parameters of step (a-2-2) are updated according to the following equations

$$\mu_j^{t+1} = \frac{\sum_{l=1}^{N} p(j|v[l])^t v[l]}{\sum_{l=1}^{N} p(j|v[l])^t},$$

$$(\sigma_j^2)^{t+1} = \frac{\sum_{l=1}^{N} p(j|v[l])^t (v[l] - \mu_j^t)^2}{\sum_{l=1}^{N} p(j|v[l])^t}, \text{ and}$$

$P(j)^{t+1} = \frac{1}{N}\sum_{l=1}^{N} p(j|v[l])^t$, wherein t is a positive integer representing a number of iterations.

12. (original): The method of claim 11, wherein the estimated parameter set of step (a-2-2) using N data v[l] is given as $\{P(j)^N \mu_j^N, (\sigma_j^2)^N\}$, and the updated parameter set for new data v[N+1], coming in, is calculating using the following equations:

$$\mu_j^{N+1} = \mu_j^N + \theta_j^{N+1}(v[N+1] - \mu_j^N),$$

$$(\sigma_j^2)^{N+1} = (\sigma_j^2)^N + \theta_j^{N+1}[(v[N+1] - \mu_j^N)^2 - (\sigma_j^2)^N],$$

$$P(j)^{N+1} = P(j)^N + \frac{1}{N+1}(P(j|v[N+1]) - P(j)^N), \text{ and}$$

$$(\theta_j^{N+1})^{-1} = \frac{P(j|v[N])}{P(j|v[N+1])}(\theta_j^N)^{-1} + 1.$$

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13. (original): The method of claim 11, wherein the step (a-2-2) further comprises: measuring a change of a probability distribution function which is defined as

$$\rho = \frac{\int(\hat{p}_{old}(x) - \hat{p}_{new}(x))^2 dx}{\int \hat{p}_{old}(x)^2 dx}$$ for each dimension, wherein a previous probability distribution function is $\hat{P}_{old}(x)$, and an updated probability distribution function is $\hat{P}_{new}(x)$; and

updating an approximation for the dimension if ρ is larger than a predetermined threshold value.

14. (original): The method of claim 2, wherein step (a-3) further comprises dividing a probability distribution function into the plurality of grids to make areas covered by each grid equal, wherein the plurality of grids have boundary points defined by c[*l*], *l* = 0, . . . , 2^b, where b is a number of bits allocated and wherein the boundary points satisfy a criterion,

$\int_{c[l]}^{c[l+1]} \hat{p}(x)dx = \frac{1}{2^b}\int_{c[0]}^{c[2b]} \hat{p}(x)dx$, and wherein the estimated probability distribution function is $\hat{p}(x)$.

15. (new): The method of claim 1, wherein the feature vector data space is in a plurality of dimensions and the feature vector data is in one dimension.

16. (new): The method of claim 2, wherein the feature vector data space is in a plurality of dimensions and the feature vector data is in one dimension.